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ABSTRACT

The principal purpose of this project was to find what, if any, early indicators exist to identify incoming students whose academic performance in high school would be high. The corollary objective was to consider what types of intervention strategies might be designed to assure that students so identified would fulfill their early promise. An initial list of 33 possible early predictors was developed, including Comprehensive Tests of Basic Skills scores, intelligence test scores, number of semesters in accelerated classes, and record of absence. Six hundred high-performing students in the Glenbrook (Illinois) High Schools were sampled for this study. The Preliminary Scholastic Aptitude Test (PSAT) score was the criterion measure. The best predictors of PSAT verbal scores were mid-eighth-grade measures of reading comprehension, vocabulary, and verbal IQ; the best predictors of PSAT quantitative scores were math computation, math concepts, math applications, and non-verbal IQ. Based on these results, it is recommended that Glenbrook choose a more difficult predictor test; it is also suggested that the most productive approach to intervention would be to identify students predicted to be highest in one area and intervene in the weaker area. (BW)

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Early Identification of High Performers

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Introduction

The principal purpose of this project was to find what, if any, early indicators existed to identify incoming students whose academic performance in high school would be high. The corollary objective was to consider what types of intervention strategies might be designed to assure that students so identified would fulfill their early promise. As later sections of the report will demonstrate, the findings are interesting from the perspectives of both researchers and practicing educators.

Method

It was determined that regression analysis was the appropriate statistical technique, since it allows us to regress a high-performance measure on a range of possible predictors in order to select those that actually predict. The nature of the question placed certain requirements on the selection of measures. A measure of high performance required a dependent variable available after students had completed a substantial portion of their secondary experience. Early indicators had to be drawn from information existing at or around the point of high-school entry.

This study uses Preliminary Scholastic Aptitude Test (PSAT) scores as the measure of high performance. The PSAT is taken by almost all high-performing students in such a district as Glenbrook. It has an added advantage over alternative measures (e.g., class rank, grade point averages, SAT scores, ACT results, or some compiled variable that might include Advanced Placement examination scores): the PSAT is designed to make fine discriminations at the very highest performer level since it is used as the basis for selecting National Merit Scholar semi-finalists. Because the study's focus was on high performers, the choice of the PSAT was warranted.

An initial list of thirty-three possible early predictors was developed based on available information. In general, the information related to students' performance on achievement tests and their course enrollments. These data covered students' records from the period between mid-eighth grade and the beginning of eleventh grade. (We

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parenthetically note that we were unable to obtain similar information from sixth and seventh grade records.) The original 33 variables are specifically identified in the following list:

Class Rank

1. Academic class rank
2. All-subjects class rank

CTBS Achievement Test Scores: Mid-Eighth-Grade

3. Vocabulary
4. Reading comprehension
5. Reading total (Vocabulary + Comprehension)
6. Language mechanics
7. Language Expression
8. Spelling
9. Language total (Mechanics + Expression + Spelling)
10. Mathematics computation
11. Mathematics concepts
12. Mathematics applications
13. Mathematics total (Computation + Concepts + Applications)
14. Total battery (Reading total + Language total + Mathematics total)
15. Reference skills

IQ Scores

16. Verbal IQ score
17. Non-verbal IQ score
18. Total IQ

Junior High Attended

19. Junior high (ten categories)

Number of Semesters in an Accelerated Class by Subject in Grade 9

20. English
21. Mathematics
22. Science
23. Social Studies
24. Foreign language

Number of Semesters in an Accelerated Class by Subject in Grade 10

25. English
26. Mathematics
27. Science
28. Social studies
29. Foreign language

PSAT Scores

30. Verbal score
31. Quantitative score

Record of Absence

32. Number of days absent in ninth grade
33. Number of days absent in tenth grade

Sample -- Six hundred high performing Glenbrook students were sampled for this study. This number includes approximately fifteen percent of the available population over the studied four-year period and represents the following groups:

1. All sixty-five National Merit Scholar Semi-finalists in the years 1980 through 1983.

2. The 135 students who received National Merit Letters of Commendation during these years.

3. 400 students whose PSAT scores placed them among the next highest fifty scores each year in each of the district's two high schools.

It is important to remember throughout the discussion of findings that we are describing a very limited and high performing student population, and that we would not expect the same results if all students had been studied.

Analysis -- Because ordinal numbers cannot be entered into regression equations; it was first necessary to convert the eighth-grade achievement test scores, which are reported as percentiles, to the expanded standard score scale available from the test publisher. For each of the 600 sampled students, measures on the thirty-three variables were next entered for a series of exploratory runs.

These early maneuvers led us to discard nine variables. It was evident that the language measures (variables #6 - #9) contributed no information once reading and vocabulary scores were entered into the regression equation. For a variety of reasons, we also dropped class rank (variables #1 and #2), junior high attended (variable #19), total battery (variable #14), and the reference skills score (variable #15). The more detailed analyses discussed below were thus confined to investigating the relationships among a final list of twenty-four variables.

Results

Table 1 reports the correlations between mid-eighth-grade reading comprehension scores and total mathematics score and eleventh-grade PSAT Verbal and Quantitative scores.

Table 1
Correlations: Reading, Math, PSAT Verbal and Quantitative

Grade		Reading Comp.	Math Total	PSAT: Verbal	PSAT: Quant.
8	Reading Comp.	X	.166	.442	-.036
8	Math Total		X	.068	.569
11	PSAT: Verbal			X	-.018
11	PSAT: Quant.				X

Several correlations in the table warrant consideration. First, we can see that the relationship between eighth-grade reading and math scores is a low .17. That is, there is a weak relationship between high performance in math and high performance in reading among high performing eighth graders. In contrast, we would expect a correlation of around .9 if all students had been included in the analysis, since it is generally the case that students who perform high in math also perform high in reading, and vice versa. This generalization, however, does not hold for the restricted range of the top fifteen percent. The implications of this finding are reserved for discussion in a later section.

Second, we note that there is a higher correlation (.44) between eighth-grade reading comprehension and eleventh-grade performance on the verbal section of the PSAT, but that the reading scores of eighth graders seem to have no relationship to their PSAT quantitative scores. As we would expect, however, their eighth-grade mathematics performance is strongly related to the PSAT quantitative scores.

It should be noted that low correlations within restricted population ranges can be entirely due to reductions in variability in one or both of the measures. In this case, however, the reduction in variability on the eighth-grade achievement scores in less than a quarter when compared to a full range of students; and the reduction in variation in the PSAT scales is about one third for the quantitative and slightly less than that for the verbal. We are therefore able to say with confidence (and considerable interest) that the correlation between the verbal and quantitative scores for these high performers is very close to zero.

Table 2 reports the correlations among the CTBS reading comprehension scores, the CTBS mathematics sub-test scores, the IQ sub-tests, the PSAT verbal and quantitative scores, and the numbers of days absent in ninth and tenth grades.

Table 2
Correlations: CTBS, IQ, PSAT, and Absences

Variables	Reading Computation	Math Computation	Math Concepts	Math Applications	IQ: Verbal	IQ: Non-Verbal	PSAT: Verbal	PSAT: Quant.	9th Gr. Absences	10th Gr. Absences
Reading Comp.	X	.15	.17	.11	.44	.16	.44	-.04	-.04	-.07
Math Computation		X	.59	.60	.05	.40	.01	.52	-.16	-.14
Math Concepts			X	.53	.10	.42	.10	.51	-.09	-.11
Math Applications				X	.10	.39	.10	.60	-.08	-.08
IQ: Verbal					X	.22	.58	.00	-.02	.05
IQ: Non-Verbal						X	.20	.41	-.04	-.07
PSAT: Verbal							X	-.02	-.02	.02
PSAT: Quant.								X	-.09	-.15
9th Gr. Absences									X	.55
10th Gr. Absences										X

As the table shows, all three mathematics sub-test scores are good predictors of the PSAT quantitative score. To a slight degree, the math applications score is the best. At the same time, the math sub-tests are very poor predictors of the PSAT verbal score, and math computation is clearly the poorest, having no relationship at all.

The correlations between IQ scores and PSAT scores indicate that: (1) Verbal IQ is a better predictor of PSAT Verbal score than is the CTBS Reading Comprehension score; (2) Verbal IQ is uncorrelated with PSAT Quantitative scores; and (3) Non-verbal IQ has a much stronger relationship to PSAT Quantitative scores than to PSAT Verbal scores.

We draw your attention as well to the absence data in the table. Most of the values are very low, but nevertheless negative, suggesting that performance declines as absence rises. The -.16 correlation between ninth-grade absences and math computation scores approaches significance. The negative correlation between absenteeism and PSAT Quantitative is low but persistent. We can see, moreover, that absenteeism is not a random process: the correlation between ninth-and tenth-grade absences is substantial.

Table 3 shows some of the relationships among students' eight-grade achievement scores, the number of semesters students were enrolled in ninth-and tenth-grade accelerated English and math courses, verbal IQ, and PSAT scores.

Table 3
Correlations: CTBS Scores, Accelerated Classes, and PSAT Scores

Variables	1	2	3	4	5	6	7	8	9
1. Reading Comp.	X	.17	.44	.36	.14	.33	.07	.44	-.04
2. Math Total		X	.12	.28	.58	.26	.27	.07	.57
3. IQ: Verbal			X	.35	.01	.26	-.04	.58	.00
4. Accel. Eng. (9)				X	.28	.65	.22	.31	.10
5. Accel. Math (9)					X	.31	.79	.00	.49
6. Accel. Eng. (10)						X	.31	.29	.11
7. Accel. Math (10)							X	-.02	.55
8. PSAT Verbal								X	-.02
9. PSAT Quant.									X

The table allows us to make the following points:

1. If we wanted a single predictor of enrollment in a ninth-grade accelerated English class, reading comprehension score or verbal IQ would serve equally well.
2. As we would expect, students' eight-grade total math achievement scores are fairly good predictors of enrollment in ninth-grade accelerated math.
3. Students in ninth-grade accelerated classes tend to enroll in tenth-grade accelerated classes, and especially so in math.
4. Relationships between enrollment in accelerated math courses and PSAT quantitative scores are higher (.49 and .55) than the relationships between enrollment in accelerated English and PSAT verbal scores (.31 and .29).
5. In view of data previously presented, it is somewhat surprising that the correlation between enrollment in an accelerated ninth-grade English and math classes is a fairly high .28.

Table 4 reports the multiple correlations that resulted from a series of prediction equations in which variables were systematically added in an effort to find the best set of predictors of PSAT verbal scores. Put another way, a correlation (or multiple correlation) describes how much of the variance among pupils' scores is explained by the predictor variables onto which the criterion variable is regressed.

Table 4
The Prediction of PSAT Verbal Scores

Variable Added to Prediction Equation	Correlation
Total CTBS Reading Achievement Score	.5638
+Total CTBS Math Achievement Score	.5646
+IQ: Verbal	.6438
+IQ: Non-Verbal	.6480
+Semesters Enrolled in Ninth-Grade Accelerated English Class	.6490
+Semesters Enrolled in Tenth-Grade Accelerated English Class	.6549

As the table shows, the correlation between reading score and PSAT verbal is a fairly strong .56. Almost no information is added by math scores; however, Verbal IQ makes a considerable contribution to our predictive ability. Beyond this point in the table, the addition of the other three variables provides little further information once the other scores are known.

Table 5 presents the results of a similar regression run to explain PSAT quantitative performance. We see that the total math

Table 5
The Prediction of PSAT Quantitative Scores

Variable Added to Prediction Equation	Correlation
Total CTBS Math Achievement Score	.5689
+Total CTBS Reading Achievement Score	.5855
+IQ: Verbal	.5857
+IQ: Non-Verbal	.6214
+Semesters Enrolled in Ninth-Grade Accelerated Math Class	.6447
+Semesters Enrolled in Tenth-Grade Accelerated Math Class	.7596

score is highly correlated with PSAT quantitative; total reading adds little information once we know math. Non-verbal IQ makes a small contribution, but not until we add enrollment in tenth-grade accelerated mathematics do we obtain a substantial amount of predictive power. The final multiple correlation of .76 is substantial.

Panels A and B of Table 6 show the multiple correlations that result if we use "wrong-way" predictors, attempting to predict quantitative performance on the basis of language variables and the reverse. Comparison of the table with Tables 4 and 5 will underscore

Table 6
PSAT Predictions Using Atheoretical Variables

Panel A: PSAT Quantitative

Variable Added to Prediction Equation	Correlation
IQ: Verbal	.0041
+Vocabulary Score	.0428
+Reading Comprehension	.0517
+Semesters Enrolled in Ninth-Grade Accelerated English	.1323
+Semesters Enrolled in Tenth-Grade Accelerated English	.1514

Panel B: PSAT Verbal

Variable Added to Prediction Equation	Correlation
Math Computation	.0150
+Math Concepts	.1197
+Math Applications	.1453
+IQ: Non-Verbal	.2294
+Semesters Enrolled in Ninth-Grade Accelerated Math	.2389
+Semesters Enrolled in Tenth-Grade Accelerated Math	.2467

the point that information about students' verbal and non-verbal achievements and abilities is not useful for cross-prediction.

All of the correlations presented thus far have relied on information about students' pre-secondary performance. In Table 7 we suppose that the eighth-grade achievement scores are unknown, and report our attempts

to predict PSAT performance on the basis of post-high-school-entry data. As the correlations demonstrate, information about enrollment in accelerated courses provides multiple correlations that are less substantial

Table 7
Predicting PSAT Verbal and Quantitative Scores
With High-School Course Enrollment Data

Panel A: PSAT Quantitative

Variable Added to Prediction Equation	Correlation
Semesters Enrolled in Ninth-Grade Accelerated:	
Math	.4918
English	.4933
Science	.4975
Social Studies	.5037
Foreign Language	.5066

Panel B: PSAT Verbal

Variable Added to Prediction Equation	Correlation
Semesters Enrolled in Ninth-Grade Accelerated:	
English	.3063
Math	.3172
Science	.3726
Social Studies	.3839
Foreign Language	.3855

than those utilizing the eighth-grade data. It is nevertheless interesting to observe that our ability to predict from accelerated enrollment information is stronger for quantitative than for verbal PSAT scores.

Actual Scores -- Table 8 shows the frequency distributions of actual verbal and quantitative PSAT scores by students who were National Merit Semi-Finalists, recipients of Letters of Commendation, or among the next highest fifty scores in each school between the years 1980 and 1983. Some of our recommendations will be concerned with these data. As Table 8 indicates, the highest verbal scores occurred in the

Table 8
Frequency Distributions of PSAT Scores

	VERBAL				QUANTITATIVE			
Scores	Semi-Finalists	Commended	Other	Total	Semi-Finalists	Commended	Other	Total
77-78	0	0	0	0	9	3	2	14
75-76	2	0	0	2	4	10	2	16
73-74	0	0	0	0	2	4	6	12
71-72	4	0	0	4	14	22	17	53
69-70	9	2	0	11	4	9	19	34
67-68	5	0	0	5	5	11	14	30
65-66	14	3	1	18	9	19	28	56
63-64	11	12	4	27	4	9	40	53
61-62	4	18	7	29	0	8	45	53
59-60	4	32	14	50	1	8	42	50
57-58	1	24	30	55	0	4	31	35
55-56	0	16	68	84	0	5	31	36
53-54	0	5	49	54	0	2	18	20
51-52	0	2	84	86	0	1	15	16
49-50	0	0	31	31	0	0	20	20
47-48	0	0	31	31	0	0	6	6
45-46	0	0	15	15	0	0	1	1
43-44	0	0	10	10	0	0	5	5
41-42	0	0	0	0	0	0	2	2

75-76 category, and the lowest verbal score obtained by a National Merit Semi-Finalist student was a 58. The highest score earned by a Letter of Commendation recipient was 70, while the lowest score for a commended student was 51. The verbal scores are, in fact, quite neatly ordered, with the Semi-Finalists' score distribution out-ranking that of the Letters of Commendation group, whose performance in turn exceeds that of the highest performers.

The distribution of quantitative scores between the Semi-Finalists and the commended students is not so tidily queued. It is nevertheless obvious that the mean score among the Semi-Finalists is higher than the mean score of the commended group, and that the average scores of those receiving Letters of Commendation is higher than that of the next highest performers.

These data bring us to discussion of the formula on which National Merit awards are based and of the implications of the formula. First, the verbal score is doubled and added to the quantitative score. Second, the test publisher ranks all the weighted scores and determines the cut-off point for that year's awards. In consequence, students who qualify for awards in one year may not in the next or vice versa.

During the four years covered by the study, cut-off scores were quite stable. In two of the four years, students who scored 192 or above were Semi-Finalists; 193 was the cut-off point in the other two years.

It is therefore clear that students may earn qualifying scores through various combinations of verbal and quantitative performance. For instance, to achieve a 193, a student may -- as seven in the sample did -- score 78 on the quantitative section of the PSAT. /1/ A verbal score of 58 (2X58=116) is required to put the student past the cut-off score. Of the seven who scored the 78, five achieved Semi-Finalist status, while two qualified for neither award. Since the Letter-of-Commendation cut-off score was 177, we know that these two students' verbal scores were below 50.

The Accuracy of the Prediction Equations -- Once we have developed the prediction equations and identified the best set of predictors, it remains to test the accuracy of the predictors. This test involves the comparison of students' predicted PSAT performance with their actual PSAT performance. We do not, of course, expect that there will be a perfect match between these scores. We do expect, however, that our regression equations will give us a fairly accurate method of identifying students who should perform well in high school.

A variety of regression runs suggested that the best predictors of PSAT verbal scores were mid-eighth-grade measures of: (1) reading comprehension, (2) vocabulary, and (3) Verbal IQ; and that the best predictors of PSAT quantitative scores were: (1) math computation, (2) math concepts, (3) math applications, and (4) Non-verbal IQ. These runs additionally indicated that the inclusion of other variables did not appreciably influence our ability to predict PSAT performance.

Table 9 reports the results of predictions about the sampled students' PSAT verbal scores based on weights assigned each indicator by the regression analyses. Predicted scores were ranked from high to low and grouped by incrementally expanded categories in column one of the table. The second through the eighth columns show the actual scores of these students, while the last three columns show their total PSAT performance.

As the table shows, if we select only the students whose predicted scores placed them among the top 31 PSAT performers, we would, in fact, have selected nine students who actually scored between 66 and 75 on the test; however, thirty-one students in the sample scored between 66 and 75.

Table 9
Predictability of PSAT Verbal Scores From Eighth-Grade Measures
Of Reading Comprehension, Vocabulary, and Verbal IQ

Predicted Rankings of Student Scores By Expanding Categories	Frequency Distribution Of Actual Scores							Total Performance		
	66 - 75	64 - 65	61 - 63	60	57 - 59	56	≤ 56	Semi-Finalists	Letters of Commendation	Others
Top 31	9	3	8	4	3	2	2	11	11	9
Top 50	15	4	10	5	8	5	3	18	17	15
Top 96	21	11	22	7	16	7	12	30	36	30
Top 121	22	13	26	12	22	10	16	36	44	41
Top 201	27	17	40	20	40	20	37	47	69	85
Top 250	28	19	41	21	52	35	62	49	82	127
Total Number of Sampled Students in Score Category	31	19	46	25	80	55	256	52	116	344
High Performers Not Predicted if Select Only:										
Top 96	10	8	24	18	64	48	244	-	-	-
Top 250	3	0	5	4	28	20	194	-	-	-

Similarly, the Top 96 row figures show that, of the predicted ninety-six highest scorers, twenty-one scored between 66 and 75, eleven scored 64 or 65, and twenty-two scored between 61 and 63. In sum, had we tried to select the top highest ninety-six performers in eighth grade, we would have correctly identified fifty four and missed forty two. By contrast, we would have missed only eight of the top ninety-six had we selected 250 prior to ninth-grade entry.

The companion Table 10 presents the results of predicted student score rankings on the PSAT quantitative section. In this case, had we chosen the top 250 predicted scores, we would have missed six among the actual top 101.

Table 10
Predictability of PSAT Quantitative Scores From Eighth-Grade Non-Verbal IQ and Mathematics Computation, Concepts, and Applications

Predicted Rankings Of Student Scores By Expanding Categories	Frequency Distribution Of Actual Scores							Total Performance		
	75 - 78	72 - 74	70 - 71	69	67 - 68	65 - 66	V 65	Semi-Finalists	Letters of Commendation	Others
Top 10	6	3	0	0	0	1	0	7	2	1
Top 21	9	4	2	2	1	2	1	13	6	2
Top 39	11	9	6	5	2	3	3	18	11	10
Top 100	22	21	14	9	9	8	17	33	36	31
Top 149	25	23	23	11	13	17	37	37	50	62
Top 199	27	30	29	13	21	28	51	45	68	86
Top 240	30	31	34	17	26	35	67	46	75	119
Total Number of Sampled Students in Score Category	30	32	39	28	30	56	297	52	116	344
High Performers Not Predicted if Top 240 Selected	0	1	5	11	4	21	230	6	41	225

In short, we accurately identify about ninety-two or ninety-three percent of the upper 100 performers by selecting the top sixty each year -- or the top thirty in each of the schools. These are reasonably accurate predictions when one considers that the Comprehensive Tests of Basic Skills are: (1) a general achievement battery and not designed to select the highest performers; and (2) administered as part of the regular school testing program during the eighth grade.

Now we turn to discussing the implications of these findings for the district.

Discussion and Recommendations

Apart from their informative value, the data suggest three policy-level decisions for the Glenbrooks. The first two are strongly supported by the evidence. The third is accompanied by the caveat that it is speculative.

Predictor Test -- The first recommendation concerns the selection of a more appropriate predictor test. If the district decides to predict high performers among entering ninth graders, it should choose a test that will better serve the purpose. The PSATs are written to make fine discriminations at top achievement levels, while the CTBSs are not. Among the sampled students, few placed in percentile ranks even as low as the 70s, and almost none scored below 110 on the IQ tests. Most students who were eventual Semi-Finalists or Letter of Commendation receipts recorded scores that fell in percentile ranks in the 90s. It is thus surprising that we were as well able to predict PSAT scores as we were.

The situation is classic: a predictor test with a ceiling effect and a criterion test without. The data support this contention. In both sections of the PSAT, the very top students were under-predicted by as much as three points on average; lower performing students were over-predicted by one to one and a half points.

Clearly, a much more difficult test of reading comprehension, IQ (verbal and non-verbal), and general math would improve the predictions. The district could accomplish this in one of two ways: (1) change the general achievement tests, or (2) administer the more difficult tests to students screened as fairly high performers by the general battery. Inasmuch as we anticipate a high parent demand for an intervention program, we think it might be possible to give the tests on a voluntary basis, perhaps during the summer months.

The Foundation of an Intervention Program -- It appears that the most productive approach to intervention would be to identify students predicted to be highest in one area and intervene in the weaker area. Consider the frequency distributions reported in Table 8, for instance. Ninety-five students scored 71 or above on the PSAT quantitative test. Of these, sixty-six students were not Semi-Finalists, but they would have been with a verbal score of 61. In fact, the mean verbal score for this group was 53, placing them, on average, just eight points below award.

A program of intervntion, spread over two years, would surely move these students the necessary eight points without sacrifice to their considerable quantitative achievements. We are naturally not advocating that the district "teach for a test," but rather that it concentrate on preparing students to deal with conceptually difficult verbal material. Such a program might address word analogies, vocabulary development, and the interpretation of difficult reading material.

Other data suggest that prediction and intervention across the other dimension might succeed as well, if not better. As Table 8 shows, sixty-nine students scored above 62 on the verbal section of the test. Twenty two of the sixty nine were not Semi-Finalists, but would have come within range with a minimum quantitative score of 69. The mean quantitative score of the twenty-two students was 56.5, leaving a gap of thirteen to fourteen points.

Although the gap between earned and required scores is wider for verbal high achievers, it is probably easier to shrink through intervention: the quantitative test concerns a more narrowly defined area than does the verbal. Intervention is moreover justified on the grounds that, with or without the PSAT ahead, students need quantitative skills if they are to function at a high cognitive level in a quantitative world.

Some Thoughts About School Incentives To Specialize -- This final section does not so much offer recommendations as it raises issues that are finally resistant to data-based answers. It is surely the case here that, as the famous line has it, statistics are no substitute for judgement.

We earlier noted a low, but positive, correlation between eighth-grade reading and math scores. We have also reported a negative correlation between eighth-grade reading score and PSAT quantitative score. This fairly sharp reduction in correlation over the three-year period is repeated when we compare eighth-grade mth scores with PSAT verbal scores.

These data lead us to speculate -- but by no means to insist -- that high achieving students begin to program themselves, in terms of courses selected and effort expended, into their stronger areas and away from the weaker areas.

If this is at all so, then we need to consider the issue of early specialization. There is, at present, a substantial and nationwide program that fosters such development by administering the quantitative section of the College Boards to youngsters for selection into very advanced math courses in high school. It is not unlikely that these precocious performers will develop deeper interest and greater skills through advanced programming.

The question remains: if their attention is focused on quantitative development, and if this development occurs at the expense of their verbal achievement, ought we not concern ourselves with -- or at least wonder about -- the long-term effects on these students. And ought we not be equally concerned about the acceleration of all high performers if deceleration in the other dimension is a side effect?